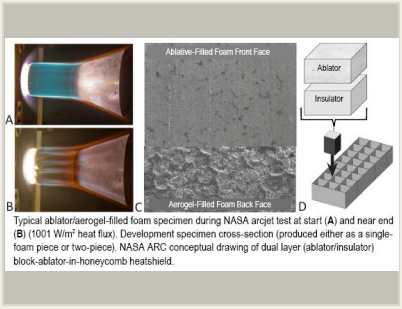
**Small Business Innovation Research/Small Business Tech Transfer**

# High Heat Flux Block Ablator-In-Honeycomb Heat Shield Using Ablator/Aerogel-Filled Foam, Phase I

Completed Technology Project (2014 - 2014)

## Project Introduction

Ultramet and ARA Ablatives Laboratory previously developed and demonstrated advanced foam-reinforced carbon/phenolic ablators that offer substantially increased high heat flux performance and reduced weight relative to conventional ablators. The structure consisted of an ablator-filled foam front surface backed by Ultramet's highly insulating aerogel-filled foam. Arcjet testing was performed at NASA ARC to heat flux levels exceeding 1000 W/cm2, with the results showing a significantly reduced ablation rate compared to conventional chopped fiber ablators, and ablation behavior comparable to FM5055 at just one-third the density. It is apparent that the foam helps retain the char layer by physical reinforcement and/or that the network of interconnected passages allows pyrolysis gases to escape with less disruption of the char layer. In 2008, NASA ARC contracted ARA to perform initial development of a new TPS design involving integration of fully cured mid-density ablator blocks within a structural honeycomb reinforcement. The block ablator-in-honeycomb heat shield is envisioned to provide high atmospheric entry reliability due to the structural attachment integrity provided by the honeycomb lattice in the ablative material layer. Any ablator failure such as cracking or char layer delamination is anticipated to occur within individual honeycomb cells rather than over large areas. The architecture is anticipated to have broad potential application for missions that involve large-vehicle entries into planetary atmospheres. Multiple block layers can be used within individual honeycomb cells, such as an outer high-density ablator layer with lightweight insulation underneath. This concept was analytically shown to have significant mass advantages over a traditional through-thickness ablator approach. Ultramet's ablator/aerogel-filled foams have very good potential for this application, and the Ultramet-ARA team will establish initial feasibility in this project.



Typical ablator/aerogel-filled foam specimen during NASA arcjet test at start (**A**) and near end (**B**) (1001 W/m² heat flux). Development specimen cross-section (produced either as a single-foam piece or two-piece). NASA ARC conceptual drawing of dual layer (ablator/insulator) block-ablator-in-honeycomb heatshield.

High Heat Flux Block Ablator-in-Honeycomb Heat Shield Using Ablator/Aerogel-Filled Foam Project Image

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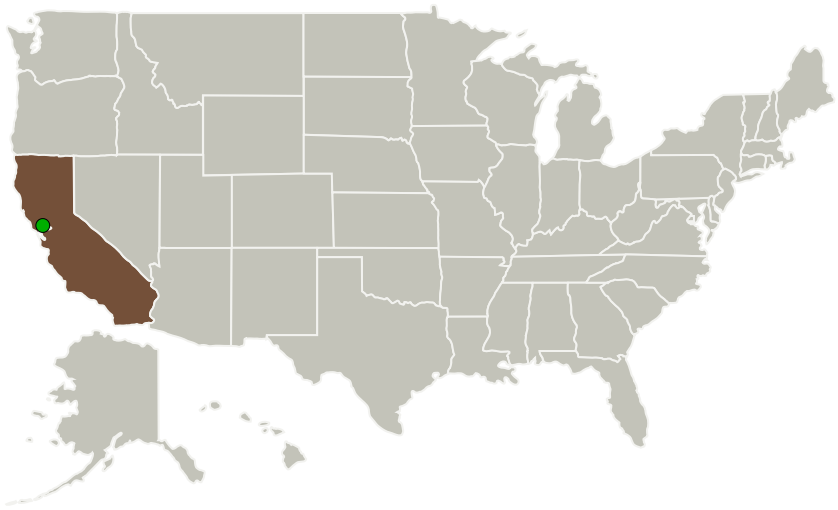
## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| Ultramet | Lead Organization | Industry | Pacoima, California |
| Ames Research Center(ARC) | Supporting Organization | NASA Center | Moffett Field, California |

| Primary U.S. Work Locations |
|---|
| California |

## Project Transitions

**June 2014:** Project Start

**December 2014:** Closed out

**Closeout Documentation:**

- Final Summary Chart*(https://techport.nasa.gov/file/140738)*

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Ultramet

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

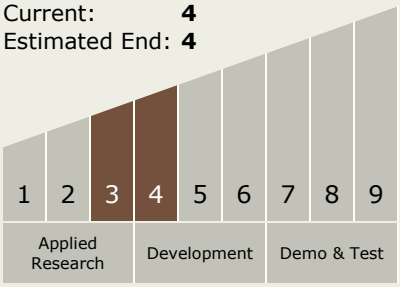
Carlos Torrez

**Principal Investigator:**

Brian E Williams

## Technology Maturity (TRL)

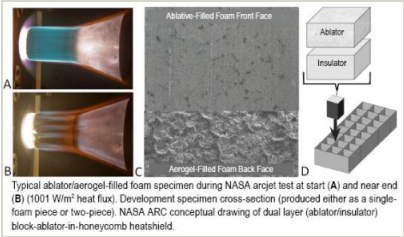
Start: **3**
Current: **4**
Estimated End: **4**



# High Heat Flux Block Ablator-In-Honeycomb Heat Shield Using Ablator/Aerogel-Filled Foam, Phase I

Completed Technology Project (2014 - 2014)

## Images




Typical ablator/aerogel-filled foam specimen during NASA arcjet test at start (**A**) and near end (**B**) (1001 W/m$^2$ heat flux). Development specimen cross-section (produced either as a single-foam piece or two-piece). NASA ARC conceptual drawing of dual layer (ablator/insulator) block-ablator-in-honeycomb heatshield.

**Project Image**
High Heat Flux Block Ablator-in-Honeycomb Heat Shield Using Ablator/Aerogel-Filled Foam Project Image
*(https://techport.nasa.gov/image/135880)*

## Technology Areas

**Primary:**

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.4 Insulation and Interfaces

## Target Destinations

Earth, The Moon, Others Inside the Solar System, Outside the Solar System, The Sun, Mars